Ph.D. Final Synopsis

Title: "STUDIES ON THE BIOLOGY AND ECOLOGY OF THE SILVERBIDDIES, *GERRES FILAMENTOSUS* (CUVIER) FROM THE NETRAVATHI-GURUPUR ESTUARIES OF MANGALORE COAST"

Ph.D. Reg.NO: MU/EXB/Ph.D./CR.86/A. Z/2006-07/E.13 Dated: 23.02.2010

Submitted by:

Narasimhaiah N

Assistant Professor & Research Scholar
Department of Applied Zoology

Mangalore University

Research Supervisor:

Dr.S.M. Shivaprakash

Professor and Head (Retired)

Department of Fisheries resource Management

College of Fisheries, Mangalore

Karnataka Veterinary, Animal and Fisheries Sciences University,
Bidar, Karnataka.

Place of Investigation:

Department of Applied Zoology, Mangalore University,
Mangalagangothri, Mangalore - 574199

April-2021

Synopsis of the thesis submitted for the award of Ph.D. degree in Applied Zoology of Mangalore University, Mangalagangothri, Karnataka, India.

Title of Thesis

''STUDEIS ON THE BIOLOGY AND ECOLOGY OF THE SILVER BIDDIES, *GERRESFILAMENTOSUS* (CUVIER) FROM THE NETHRAVATHI-GURUPUR ESTUARIES OF MANGALORE COAST"

Candidate: Narasimhaiah, N

Introduction

Gerresfilamentosus Cuvier, 1829 (Family Gerreidae) commonly known as whipfin mojarras or lined silver biddy is an important fish inthe inshore waters of Karnataka. Members of family Gerreidae are characterized by having ahighly protrusible mouth which can be extended as a tube into the substrate during feeding and a sheath of scalesalong the bases of their median fins. In India, the silver biddies constitute an important fishery in the Chilkalake, Vembanadlake, Pulicat Lake, Palk Bay, Gulf of Mannarand in the estuaries of the Uttar Kannada and Dakshina Kannada districts of Karnataka. They are tropical/subtropical euryhaline fishes while some species are even adapted to a total freshwater habitat (Austin, 1971). They are abundant in the estuaries and coastal inshore waters with sandy bottom.

In India, there are eight species of *Gerres* recorded, which are *G. oyena*Forskal, 1775; *G. filamentosus* Cuvier, 1829; *G. abbreviatus*Bleekar, 1850; *G. poieti* Cuvier, 1829; *G. lucidus* Cuvier, 1830; *G. setifer* Hamilton, 1822 and *G. oblongus* Cuvier, 1830; *G. acinaces*Bleekar, 1854 (Day, 1878). 12 Species of *Gerres* and one species of *Pentaprion* have been recorded from Indo-Australian Archipelago, which are *G. abbreviatus, G. oyena; G. poeti; G. kapas; G. punctatus; G. oblongus; G. macracanthus; G. acinaces; G. macrosoma; G. setifer, G. argyreus*and*Pentaprionlongimanus* (Weber and Beaufrot, 1931).

Fischer and Bianchi (1984) reported 9 species from Western Indian Ocean, which belong to two genera such as *Gerres*and *Pentaprion*under family Gerreidae. These were *G. abbreviatus, G. filamentosus, G. oyena; G. acinaces, G. lucidus, G. oblongus; G. poieti, G. rappi*and *P. longimanus.* The important species of *Gerres* found along Karnataka Coast are *G. filamentosus, G. setifer, G. oblongus; G. oyena*and *G. abbreviatus* (Rajagopal et al., 1978). The gerrids are highlyconsidered as food fishes and the major portion of the landings is consumed locally in fresh condition.

Marine fishes like silver biddies are highly important in contributing rich in protein. In the Indo-Pacific region, silver biddy species are economically important food under family Gerreidae. Importantly, it functions in development and economic of Indian estuaries. In fish biology, knowledge of the allometric study of length-weight and condition factor or ponderal index is an important tool. In fisheries, allometric relationship is one of the most common uses in analyzing data, notably to raise length-frequency samples or to allow the conversion of growth in length equations for growth in body weight, for use in stock assessment models (Mendes *et al.,* 2004).

Growth characteristics of fishes are an important part of population dynamics and essential parameters to take serious decision on the management issues of any fishery. Age refers to the quantified period of time when the fish lives. However, growth is the definite size changeof fish between certain periods of time. The age and growth parameters of fish provide indispensable data to understand the dynamics of ichthyological populations. Apart from this, they can also give an important indication on the fisheries management and on the level of their exploitation (Beamish and MacFarlane, 1987). With reference to the progress of fishery research, different methods have been evolved for determining the age of the fish. These methods may be broadly classified into direct (counting of year rings on

hard parts such as otoliths and scales) (McFarlane *et al.,* 2002) and indirect methods (conversion of length frequency data into age composition) (Gayanilo and Pauly, 1997).

Reproduction is a link in the life cycle of a fish, which in combination with others, ensures the continuation of the species. An investigation of the reproductive biology of a fish enables the determination of the periodicity and strength of the broods, which constitute the year class. Information is scanty on the reproductive biology of gerrids along Karnataka coast. Feeding is one of the most important functions of an organism. The basic functions of an organism like growth, development, reproduction take place at the expense of the energy which enters the organism in the form of its food. A sound knowledge of the food habits of fishes, is a prerequisite for an understanding of their general biology, including such vital aspects as growth, breeding and migration. Information on the feeding grounds of commercial fish stocks, is useful to fisherfolk and help them to expand their fishing efforts profitably. Studies on food and feedings habits have been conducted on a variety of fishes, belonging to freshwater, estuarine and marine environments. In early period, studies on food and feeding habits from India were initiated by Hornell and Naidu (1923), who worked on *Sardinella longiceps* followed by Devanesan (1932) on *S. gibbose* in India. Later many workers studied on various aspects of food and feeding of commercially important fishes. Among gerrids, Golikatte (2002) worked on the food and feeding habits of *G. filamentosus* from Sharavati estuary in Karnataka.

An early detection of water quality problems is essential to prevent the deterioration and loss of fish habitat due to pollution which is caused by rapid industrialization along the coastal areas. Assessment of the status of gerrid growing areas to find out areas threatened by pollution and initiation of remedial actions to protect and restore water quality in the affected areas is an essential requirement. Therefore, the dynamics of *G. filamentosus* population and physico-chemical parameters should be examined in relation to the changes

in the ambient environment. In India, *G. filamentosus* are in third tropic level and consumed by larger fishes. Moreover, they have established a place among people living in the south west and east coasts of India as the tasty and cheapest fish available throughout the year (Sivashanthini, 2008).A very limited information is available so far on the allometry, condition factor population dynamics, reproduction, food and feeding habits, and relationship of environmental parameters with *G. filamentosus* in Karnataka, India and therefore, the present study was undertaken to understand the life history of fish species from the natural waters of this area.

The present investigation is carried out at habitat of silver biddies with emphasis on

1. The allometric relationships and condition factor of *Gerres filamentosus*
2. Population dynamics of *G. filamentosus*
3. Reproductive biology of *G. filamentosus*
4. Food and feeding habits of *G. filamentosus*
5. Environmental parameters from the habitat of gerrid, *G. filamentosus*

Materials and Methods

The Nethravathi-Gurupur estuary is produced by the merger of the rivers Nethravathi and Gurupur which merges into the Arabian Sea near Mangalore, Karnataka. Sample gathering and analysis 3 sampling sites were documented in the estuary. Site 1 is located at the mouth of the Nethravathi-Gurupura estuary, Site 2 is selected at a stream of Gurupur river which is about 2 kilometres away from the mouth of estuary and Site 3 (near to Nethravathi bridge) is within the upstream of Nethravathi river (at a distance of 2.5

kilometres from the mouth of the estuary (Fig. 1). Sampling was made monthly and water analyses were carried out for two successive years (July, 2009-June, 2011).

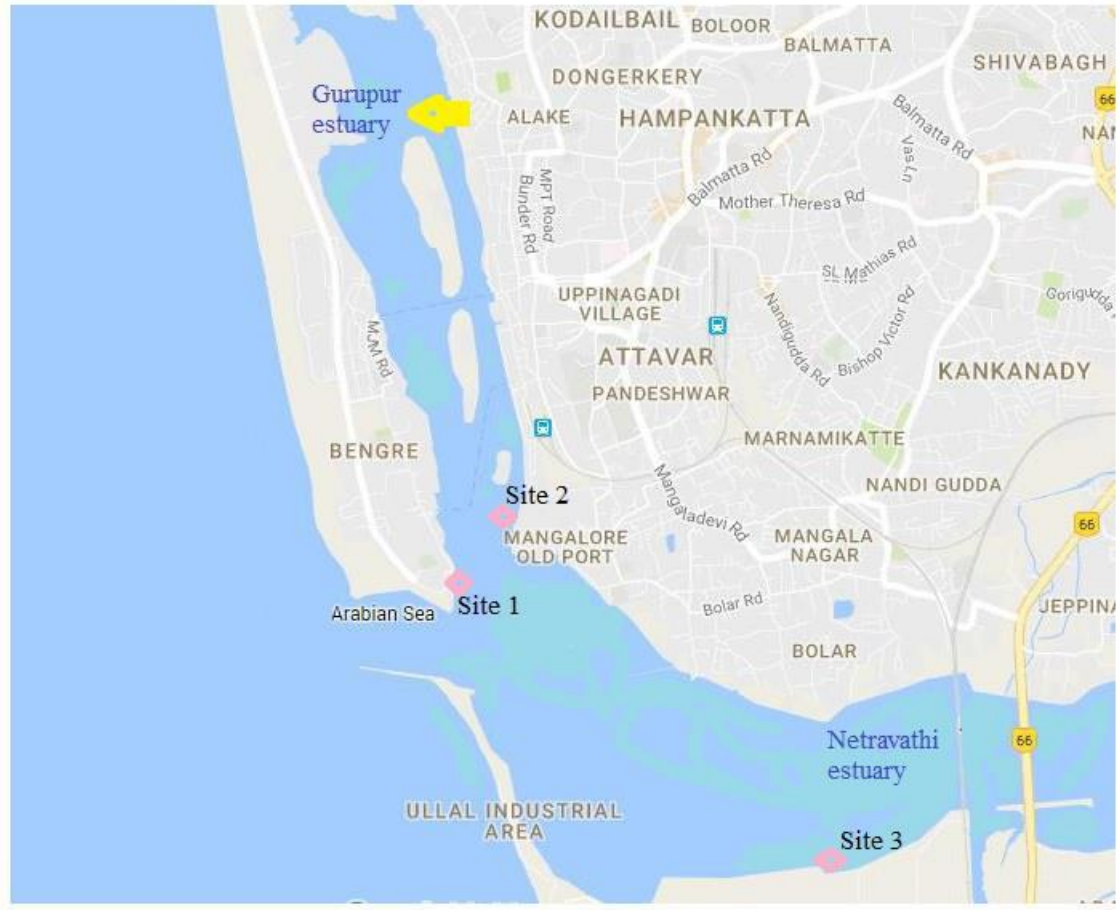

Fig 1. Location of sampling site, Bengre(Netthavathi-Gurupur estuary) Karnataka. Red circle: study area

The samples of *G. filamentosus* were analysed for recording morphometric measurements and to study the length-weight relationship and condition factor. Total length from the tip of the snout to the tip of the caudal fin, were measured to the nearest one millimetre using a graduated measuring board. Female and male individuals were identified by examining the gonads and cutting the body cavity. The present study is based on the observation of a total of 2020 individuals of *G. filamentosus* ranging in size from 52 to 300.0 mm (TL) based on the numbers of females, males and unsexed fish. Fishes were measured to the nearest millimetre and weighed to 0.001 g for *G. filamentosus* using an

electronic balance. The parabolic equation $W = aL^b$ (Le Cren, 1951) was linearized to the form Y = a + bX, where Y = log W, X = log L, "a" and "b" are constants. L is the length and W is the weight. The condition factor, Kn (Le Cren, 1951) for individual fish was calculated using the formula Kn = Wo/Wc, where Wo = observed weight and Wc = calculated weight.

Length frequency data were collected from a total of 1043 females ranging in length from 70 to 300 mm and 701 males ranging from 60 to 275 mm and grouped into 2 mm class interval. These data of *G. filamentosus* collected from the cast nets, gill nets and drift nets catches were analysed using ELEFAN I routine of FiSAT II software (Gayanilo and Pauly, 1997).Macroscopic observation was the simple visual examination of the external appearance of male and female gonads, gonad maturity stages have been modified and have only five stages in female and 4 stages in male, based on the macroscopic characteristic of species that we studied. Different stages of maturity were then defined according to the appearance of the section, its cellular composition, and for females, the development of oocytes (size and quality) (Noor, 2013).The average length at first maturity (Lm) was determined by tabulating the percentage of fishes in stage III and above against their length.Gonado-somatic Index (GSI) was calculated by using the formula:weight of the gonad/weight of the fish x 100 (James, 1967).

Both qualitative and quantitative analyses were carried out to study the feeding habits of *G. filamentosus* during July, 2010-June, 2011.Feeding intensities in different months were studied by the degree of fullness of the stomach in relation to the size of the fish. Air Temperature and surface water temperature was recorded by using Centigrade thermometer. The pH, salinity and conductivity of the water samples were measured using Systronics, Water Analyser 371 kit. The dissolved oxygen, free carbon dioxide, phosphate

and nitrate concentrations from the water samples were analysed according to standard methods of APHA (1998), and Strickland and Parsons (1972).

Results and Discussion

The silverbiddies, *G. filamentosus* is important in commercial value. It finds a place in the market in diversified forms. Presently, it has a great demand in some areas of Asian countries and other countries. Exploratory survey conducted by Department of Fisheries, India (2020) has indicated that 0.07 lakh tonnes of gerreids were captured in Karnataka coast during 2019-2020.Thus, in the light of its importance, the present study was aimed at investigating into the biology and population characteristics of *G. filamentosus* from Mangalore waters.

G. filamentosus is a omnivorous species feeding on free swimming organisms near to the bottom and directly to the bottom. The presence of sand grains, detritus, benthic organisms in the stomach of *G. filamentosus* indicate that they browse at water bottom for food. The relation between the total length (L) and total weight (TW) was described as LogTW = -1.7716 + 2.9511 Log L for females, Log TW = -1.7526 + 2.9364 LogL for males and LogTW = -1.8343 + 2.9720 LogL for indeterminate fishes. The highest and lowest condition factor (Kn) values in females was in December 2010 (1.1186) and September 2010 (0.8871) respectively. Similarly, the highest and lowest Kn values in male was in March 2011 (1.0630) and September 2010 (0.6977) respectively. The result of length-weight relationships could be used for fishery to approve appropriate regulations for sustainable fishery management. The present findings could also be useful for ecosystem modelling. In the present study, changes in Kn value may be in relation to some other reasons than reproductive cycle and feeding intensity.

Population parameters of *G. filamentosus* Cuvier, 1829 (Family: Gerreidae) along the south west coast of India were assessed using FiSAT II software for samples collected from July, 2009 to June, 2011. The asymptotic lengths (L_∞), growth constants (K) and lengths at first maturity (Lm_{50}) for female and male were 304.5 mm, 0.40 $year^{-1}$, 203.0 mm and 283.5 mm, 0.45 $year^{-1}$, 189.0 mm respectively. The annual instantaneous rates of total mortality (Z), fishing mortality (F), the natural mortality (M) and the lengths at first capture for female and male were estimated at 1.43 $year^{-1}$, 0.98 $year^{-1}$, 0.45 $year^{-1}$ and 123.5 mm, and 1.49 $year^{-1}$, 1.08 $year^{-1}$, 0.41 $year^{-1}$ and 130.9 mm respectively. The exploitation rate was 0.31 for females and 0.28 for males. The values of exploitation rates for female and male were found to be lower than 0.50 (optimum level), which pointed toward under fishing condition in the fishery of Mangalore.

The percentage occurrence of food items in the stomach contents in both the sexes of *G. filamentosus* were found to vary with months considerably. During July, 2009-June, 2011, the highest percentage of food items was Polychaetes in both the sexes, whereas the lowest percentage was Sponge spicules in both the sexes. The maturity stages of male and female *G. filamentosus* were classified into four stages of testes and five stages of ovary. Two reproductive peaks were observed in male, one in November 2009 (1.5606) during July, 2009-June, 2010 and another one was in November 2010 (1.5708) in July, 2010-June, 2011. Whereas the two reproductive peaks were observed in female, one in May 2010 (1.7972) in July, 2009-June, 2010 and another one in July 2010 (1.7778) in July, 2010-June, 2011.

In the present study, seasonal fluctuations were noticed for majority of the physico-chemical parameters studied during July, 2009-June, 2011. South west monsoon rainfall and municipal discharge seem to play an important role in altering the physico-chemical parameters of the estuarine waters. Generally, Among the physico-chemical parameters,

water temperature, pH, salinity and dissolved oxygen are important for the survival of this fish species. The temperature and salinity values were lower during monsoon than during pre-and post-monsoon seasons. The dissolved oxygen and pH concentrations were observed to be uniform throughout the estuarine waters with minimum seasonal variations. Spawning activity of this species seems to coincide with south west monsoon season when there is a fall in salinity and water temperature and a relative concentration increase in dissolved oxygen.

References

1. APHA., 1998. Standard methods foe examination of water and wastewater. APHA AWWA WPCF, Washington, D.C.
2. Austin, H M.,1971. Some aspects of the biology of the rhomboid mojarra *Diapterus rhombeus* in Puerto Rico. Bull. Mari. Sci**.** 21: 886-903.
3. Beamish, R. J. and MacFarlane, G. A., 1987. Current trends in age determination methodology. In: Age and growth of fish. R. C. Summerfelt and G. E. Hall (eds.). Iowa State University Press, Ames, 15-42 pp.
4. Department of Fisheries, 2020. Handbook of fisheries statistics. Government of India, New Delhi.
5. Gayanilo, F. C. J. and Pauly, D., 1997. FAO-ICLARM stock assessment tools (FiSAT) reference manual. FAO, Rome.
6. Golikatte, R., 2002. Some biological aspects and fishery of the whipfin silverbiddy *Gerres filamentosus,*from Sharavati estuary, central west coast of India. PhD thesis, Karnatak University, Kodibag Karwar.

7. Hornell, J. and Naidu, M. R., 1923. A contribution to the life history of the Indian sardine with notes on the plankton of the Malabar coast. Madr. Fish. Bull. 17: 129-197.
8. James, P. S. B. R., 1967. The ribbon-fishes of the family Trichiuridae of India. Mar. Biol. Ass. India. 1: 1-226.
9. Le Cren, E. D., 1951.The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *Perca fluviatilis*. J. Anim. Ecol. 20: 201-219.
10. McFarlane, G. A., King, J. R. and Sauders, M. W., 2002. Preliminary study on the use of neural arches in the age determination of bluntnose six gill sharks (*Fexanchus griseus*). Fish. Bull. 100: 861-864.
11. Mendes, B., Fonseca, P. and Campos, A., 2004. Weight-length relationships for 46 fish species of the Portuguese west coast. J. Appl. Icht. 20: 355-361.
12. Noor, N. S. B. M., 2013. Some biological aspects of *Gerres filamentosus* (Cuvier, 1829) in Merbok estuary, Kedah, Peninsular Malaysia. PhD thesis, Universiti Sains Malaysia, Penang.
13. Sivashanthini, K., 2008. Length-weight relationships and condition of gerreids (Pisces: Gerreidae) from the Parangipettai waters (SE coast of India). Asia. Fish. Sci. 21: 405-419.
14. Strickland, J. D. H. and Parsons, T. R., 1972. A practical hand book of seawater analysis. Fisheries Research Board of Canada. Ottawa.
15. Weber, M. and De Beaufort, L.F., 1931. Fishes of the Indo-Australian Archipelago. E. J. Brill ltd., Leiden.

PUBLICATION AND PRESENTATION

List of publications:

1.**N. Narasimhaiah,** K. P. Rajashekhar, S. M. Shivaprakash, and S. Y. Tenjing, 2021. Population dynamics of commercial fish, *Gerres filamentosus* Cuvier, 1829 (Family: Gerreidae) along the coast of south west India. *Thalassas*37: 851-859.

2.**N. Narasimhaiah,** K. P. Rajashekhar, S. M. Shivaprakash and S. Y. Tenjing, 2021. Allometry and condition factor of whipfin silverbiddy, *Gerres filmentosus* from Mangalore Coast, Karnataka, India. *Indian Journal* of Animal Research.55: 324-332.

List of research papers presented in Conferences/Seminars:

1**. N. Narasimhaiah**, K. P. Rajashekhar, S. M. Shivaprakash, and S. Y. Tenjing, 2019. Presented a research paper on "Population dynamics of *Gerres filamentosus* Cuvier, 1829 from Karnataka Coast, India" in an international conference entitled "International Conference on Benthos", 6-8 March 2019, Cochin University of Science and Technology, Kerala, India.

2. **N. Narasimhaiah**, K. P. Rajashekhar, S. M. Shivaprakash, S. Y. Tenjing, 2019. Presented a research paper on "Allometry and condition factor of *Gerres filamentosus* Cuvier,1829 from Mangalore Coast, India", in an international conference entitled "International Conference on Benthos", 6-8 March 2019, Cochin University of Science and Technology, Kerala, India

3.**N. Narasimhaiah**, K. P. Rajashekar and S. M. Shivaprakash, 2017. Presented a research paper on "Reproductive biology of male whipfin silverbiddy, *Gerres filamentosus* (Cuvier,1829) off Mangalore Coast" in a national conference entitled "National Conference on Reaching the Unreached through Science and Technology: Recent Advances Physical, Chemical, Mathematical and Biological Sciences for Energy, Health and Environment", 8-9 September 2017, Mangalore University, Mangalagangothri, Karnataka, India.

4. **N. Narasimhaiah**, K. P.Rajashekhar and S. M. Shivaprakash, 2016.Presented a research paper on "Reproductive biology of female Whipfin silverbiddy, *Gerres filamentosus* (Cuvier,1829) off Mangalore Coast" in a national conference entitled "XXVI National Symposium on Chronobiology", 2-3 June 2016, University of Mysore, Karnataka, India.

5.**N. Narasimhaiah**, K. P.Rajashekhar and S. M. Shivaprakash, 2015. Presented a research paper on "Food and feeding habits of *Gerres filamentous* (Cuvier, 1829) off Mangalore coast, Karnataka", in a national conference entitled "National Conference on Recent Advances in

Animal Sciences", 13-15 February 2015, Mangalore University, Mangalagangothri, Karnataka, India.

6. **N. Narasimhaiah**, K. P.Rajashekhar and S. M. Shivaprakash., 2012. Presented a research paper on "Gonado-soamtic index of the whipfin silver biddy *Gerres filamentous* (Cuvier, 1829) of Mangalore coast, Karnataka, India" in a national conference entitled "National Seminar on Recent Advances in Biological Sciences", 28-29 February 2012, St. Aloysius College, Mangalore, Karnataka, India.

7.**N. Narasimhaiah**, K. P. Rajashekhar and S. M. Shivaprakash, 2011. Presented a research paper on "Length-weight relationship and relative condition factor of *Gerres filamentosus*(Cuvier, 1829) of Mangalore Coast, Karnataka", in a national conference entitled "9th Indian Fisheries Forum", 19-23 December 2011, at Chennai, Central Marine Fisheries Research Institute, Kochi, Kerala, India.